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Fostering Project Performance by Information Integration: An Information Technology Enabled Stakeholder Approach

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Abstract: The intricacy of the construction supply chain and the interactions among various actors in construction projects highlight the important role of Information Technology capability and efficient information flow integration to guarantee seamless coordination and communication among stakeholders. This study investigates the association between Client/Owner, Contractors, supplier's Information Technology capabilities, and information flow integration. Regression analysis is used to examine the data and ascertain the relationships between these variables. The findings indicate that information flow integration, each entity's Information Technology capability, and construction project performance are positively correlated. Information Technology capability allows key players in a construction project to integrate information and ultimately improves the performance of construction projects. According to the research, better project performance may result from strengthening Information Technology capability and integrating information flow among the Construction Project's partners. The significance of investing in Information Technology Capability and encouraging efficient communication and cooperation between clients, contractors, and suppliers are important takeaways from these findings for patrons in the construction industry.

Keywords: Information technology capability, Information integration, Construction industry, Communication, Project performance

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INTRODUCTION

Extending the well-established relationship between Information Technology Capability (ITC) and information flow integration in the construction sector, other aspects shed light on the numerous benefits that arise from implementing cutting-edge IT tools. Effective remote project management is made possible by the construction industry's ability to use information technology, which is essential in today's globalized world of unforeseen events. Tools for remote project management help make construction operations more flexible and resilient. Clients/owners, contractors, and suppliers are the organizational entities involved in the complicated and dynamic construction industry. These organizations need to successfully integrate information flow as a prerequisite for construction operations to achieve their objectives. The integration of information flow in the construction sector is significantly facilitated and improved by Information Technology Capability (Hasnain & Pasha, 2022). It's the ability of an organization to employ information technology to assist in business operations and decision-making. Information technology capability is incorporated to promote higher levels of cooperation and communication in the construction industry. Stakeholders can exchange information in real-time through collaborative tools and sophisticated communication platforms, which makes it easier to share project updates and make decisions as a group. This beneficial association between Information Technology Capability and information flow integration in the construction industry has been established in numerous researches.

It is discovered that Information Technology Capability has an advantageous impact on the way construction operations work (Hasnain & Pasha, 2022). This research used Regression analysis to identify this association, which showed that higher Information Technology Capability levels are associated with more proficient project performance. Similarly, another research highlighted the endless role that Information Technology Capability plays in creating an effective information flow integration in the Construction Industry (Govorukha, 2021). It has been explored that information technology capability is incorporated to promote higher levels of cooperation

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and communication in the construction industry. Stakeholders can exchange information in real-time through collaborative tools and sophisticated communication platforms, which makes it easier to share project updates and make decisions as a group.

The significance of Information Technology Capability for the Integration of Information is not just limited to the Construction industry rather literature also emphasizes the strategy of utilizing information technology to boost the manufacturing sector's competitiveness (Liu & Xu, 2016), which is consistent with the construction sector's requirement for efficient information flow integration. Similarly, the literature shed noteworthy emphasis on the substitutive and synergistic functions of information technology in software teams' knowledge integration (Mehta et al., 2022). Based on this knowledge, it's evident that Information Technology Capability may help different entities in the construction sector to integrate their expertise and information, improving managerial decisions and coordination. The construction industry's use of advanced document management systems is directly related to its information technology capabilities. These systems contribute to improved efficiency and transparency throughout the project lifecycle by improving the organization and accessibility of project documentation and guaranteeing stakeholders have access to accurate and up-to-date information.

Additionally, it has been proved that the integration of information flow made possible by information technology capability directly affects project performance (Hasnain & Pasha, 2022). It is also emphasized how crucial information technology capability is to risk identification and mitigation. Cutting-edge decision support systems reduce project risks by offering thorough insights into possible obstacles and supporting proactive risk management techniques. This empowers stakeholders to make decisions that are well-informed and made on time. Better communication, collaboration, and coordination amongst the parties involved in building projects is rendered achievable by improved information flow integration (Kania, Radziszewska-Zielina, & Śladowski, 2020). This results in improved cost management, scheduled activities adhesion, and exceptional finished products for Construction projects (Arantes & Ferreira, 2020). Client satisfaction rises as a result of information technology capability's improved information flow. Open lines of communication and easy access to project data foster trust, which improves client satisfaction by increasing understanding, participation, and transparency throughout the building process.

Information technology capability has a significant impact on project performance directly as well as indirectly by supporting other capabilities in the construction sector. For instance, it allows suppliers to innovate in construction projects (Sariola, 2018). One direct result of information technology capability is resource optimization. Project teams can guarantee the efficient allocation and utilization of resources by utilizing technology tools to facilitate efficient resource management. Because resources are used wisely, this optimization directly affects project performance and raises the general effectiveness of construction projects. Suppliers can contribute to innovation and improvement of building processes and results by utilizing information technology tools and systems. In addition, Information technology capability helps to coordinate different aspects of building projects. Project managers can effectively oversee timelines, allocate resources wisely, and track progress by using sophisticated project management software. In addition to streamlining managerial decisions, the synergy produced by this information integration guarantees that project teams are cooperating to achieve shared goals. Essentially, information technology capability acts as a stimulant for collaboration in the building industry. Its capacity to enable the integration of knowledge and data opens the door for better managerial decision-making and coordination, which in turn promotes a cooperative atmosphere favorable to the successful completion of projects.

Information Technology Capability also aids knowledge management initiatives in the building sector by encouraging content sharing, decision-making, and the open exchange of ideas (Boamah et al., 2021). It is clear that information technology capability has a complex impact on project performance in the construction industry. Information technology systems and tools support innovation, knowledge management, effective resource use, risk reduction, and improved teamwork through both direct and indirect effects. These combined effects highlight how crucial information technology is to achieving successful results in the dynamic and intricate world of building projects.

LITERATURE REVIEW

To achieve the goals of the study and represent the research problem's theme, first information technology capability is chosen to learn about its relationship with information flow integration, and then the effect of information technology capability on project performance is examined after pilot testing. Variables under investigation are defined and explained below:

- Information flow integration for supply chain coordination: The maximum level of information sharing ranges from the operational level to the strategic level to achieve supply chain coordination (Ravi et al., 2006)
- Information technology (IT) capability: It measures the sophistication of Information Technology infrastructure through ease and increasing coordination by timely and accurate data sharing (Sunil et al., 2008)
- Performance: The perception of respondents about the Project's ability to achieve its objectives from technical and commercial perspectives (Stephen et al., 2003)

Information flow integration for supply chain coordination and Construction Industry

In conjunction with the construction industry, information flow integration for supply chain coordination corresponds to the smooth and effective communication of data between the main players involved in construction projects, such as the client, contractor, and supplier. The goal of this integration is to increase collaboration and exchange of information amongst many stakeholders across construction projects, therefore improving the project's overall success.

Information exchange is essential for encouraging cooperation and coordinated actions among supply chain participants (Formoso & Isatto, 2011). It sets them in motion and fosters mutual insight of the goals and specifications of the project. Information exchange is especially crucial for construction execution during weekly work planning meetings since it enhances collaboration regarding projects and its execution (Retamal et al., 2020).

Numerous strategies and technologies can be used to enhance information flow integration. In a Building Information Modelling (BIM) context, for instance, the usage of 4D scheduling with the Last Planner System can improve the visualization and transmission of electronic fabrication and scheduling data (Tauriainen & Levaniemi, 2020). Enhancing information flow during the construction phase can also be achieved by integrating with Enterprise Resource Planning (ERP) systems. It has been observed that Collaboration, sustainability, and integration throughout the precast supply chain phases can only be improved with effective communication and access to accurate and current information (Abedi et al., 2015). Computerized systems for cloud computing can be used to enhance sharing of information and streamline supply chain management. Furthermore, integrating the construction supply chain with BIM can improve stakeholder synergy and cooperation (Papadonikolaki et al., 2015). Moreover, a crucial component of construction project management is the coordination of finance, information, and material movement among pertinent parties (Sathvik et al., 2022). In the construction business, supply chain coordination through information flow integration is essential to enhancing project performance. Improved coordination and communication between the supplier, contractor, and client can help stakeholders collaborate more successfully, which will boost productivity, cut down on delays, and improve project results.

Information technology (IT) capability and Construction Industry Information technology (IT) capability implies the business's capacity to use and employ IT technologies and set up to enhance interaction and collaboration between suppliers, contractors, and clients (Yang & Huang, 2016). The competency, abilities, and resources needed to organize and execute IT solutions that improve project performance are all included in IT competency. Studies have indicated that integrating information platforms into project planning, appraisal, architecture, and implementation stages can improve technological innovation capacities, including R&D and deployment of resources (Yang & Huang, 2016). The cost, quality, and overall impact of the project performance; all function better when the aforementioned capabilities are used.

Moreover, the proficiency of IT is essential for resolving delays in the building sector. Construction projects frequently have delays, however, IT solutions can reduce these delays by enhancing stakeholder communication and interaction (Sambasivan & Soon, 2007). Instantaneous information sharing, teamwork, and management decisions are made possible by effective IT capabilities, which can reduce disruptions and boost project effectiveness. Information Technology competence extends to supplier capabilities in the construction industry, in addition to enhancing communication and teamwork. It has been studied that supplier capabilities are context-specific and might change based on the objectives of the project and the client's requirements. Suppliers can create efficacy in the supply chain and improve the overall performance of building projects by deploying resources more effectively through their improved information technology resources (Kim et al., 2016).

Furthermore, there is a strong correlation between IT proficiency and green construction strategies. In order to obtain superior sustainable performance in prefabricated construction endeavors, stakeholders must be able to use, extend, or modify their resources, including technology, investment, and management (Dang et al., 2020). By enabling resource optimization, waste reduction, and environmental control, IT tools and systems can promote sustainable construction practices (Ahuja et al., 2018).

All things considered, the construction sector needs strong IT capabilities to improve project performance through improved stakeholder coordination and communication. By utilizing IT tools and systems, organizations may effectively manage delays, improve supplier capabilities, encourage sustainable building methods, and provide lean and environmentally friendly project outputs.

Project Performance and Construction Industry

Improving coordination and communication between the supplier, contractor, and client can have a significant positive impact on the execution of construction projects (Chan et al., 2004). Successful project delivery depends on efficient collaboration and communication, which can also lead to better project results. Using key performance indicators (KPIs) to gauge construction progress is a crucial part of boosting performance. KPIs offer a numerical assessment of a project's performance and can be used to pinpoint areas in need of development. A well-defined communication channel and continual KPI evaluation allow stakeholders to keep tabs on developments, spot possible problems, and act quickly to address them.

Project management, key elements, and competent leadership are some of the components that influence Construction projects' performance. Project success is largely dependent on the customer, contractor, and supplier having effective communication and coordination (Chan et al., 2004). Aligning project objectives, controlling expectations, and making sure that everyone is working towards the same goal may all be achieved with the support of open lines of communication, ongoing discussions, and cooperative decision-making processes. In addition, suppliers are essential to construction operations since they foster innovation and strengthen project results (Sariola, 2018). Contractors can leverage suppliers' innovative potential to improve project performance by leveraging their knowledge and experience. Collaboration and effective communication with suppliers may develop a win-win partnership and open doors for innovation and Project success.

Commercial contractors also need to assess and enhance their supplier management maturity (SMM) (Liu et al., 2018). Contractors can identify opportunities for growth and invest strategies in place to improve supplier performance by evaluating the maturity level of supplier management practices. This entails creating efficient channels for communication, outlining precise standards, and giving suppliers the assistance and resources they require. In general, improving the performance of construction projects requires improved cooperation and interaction between the supplier, contractor, and client. This can be accomplished by working with suppliers, leveraging KPIs, exercising strong leadership, and continuously assessing and enhancing supplier management procedures.

Research Hypotheses

As per the objectives of this research, two types of hypotheses are developed. Information Technology Capability has a significant relationship with Information Flow Integration of the respective organizations of Client/Owner, Contractor and Supplier. Second Information Flow Integration is also associated with the Performance of the project on which the respective organization is working on. And in the end, a collective effect of Information Integration on the Performance of the project is tested irrespective of the type of the firm as the research framework shown in Figure 1. The following distinct hypotheses are designed based on the above scenario.

Type 1 :

$\mathbf{H}_{1A}$: Information technology Capability is associated with Information Flow Integration of Client/owner firm.

$\mathbf{H}_{1B}$: Information technology Capability is associated with the Information Flow Integration of the Contractor firm.

$\mathbf{H}_{1C}$: Information technology Capability is associated with the Information Flow Integration of the Owner firm.

Type 2 :

$\mathbf{H}_{2A}$: Information Flow Integration of the Client/Owner firm is associated with the Performance of the Project.

$\mathbf{H}_{2B}$: Information Flow Integration of the Contractor firm is associated with the Performance of the Project.

$\mathbf{H}_{2C}$: Information Flow Integration of the Supplier firm is associated with the Performance of the Project.

Type 3 :
$\mathbf{H}_{3A}$: The information technology Capability of Client/Owner, Contractor and Supplier firms is associated with Overall Information Flow Integration.
$\mathbf{H}_{3B}$: Information Flow Integration of Client/Owner, Contractor and Supplier firms is associated with the Performance of the Project.

Research Model

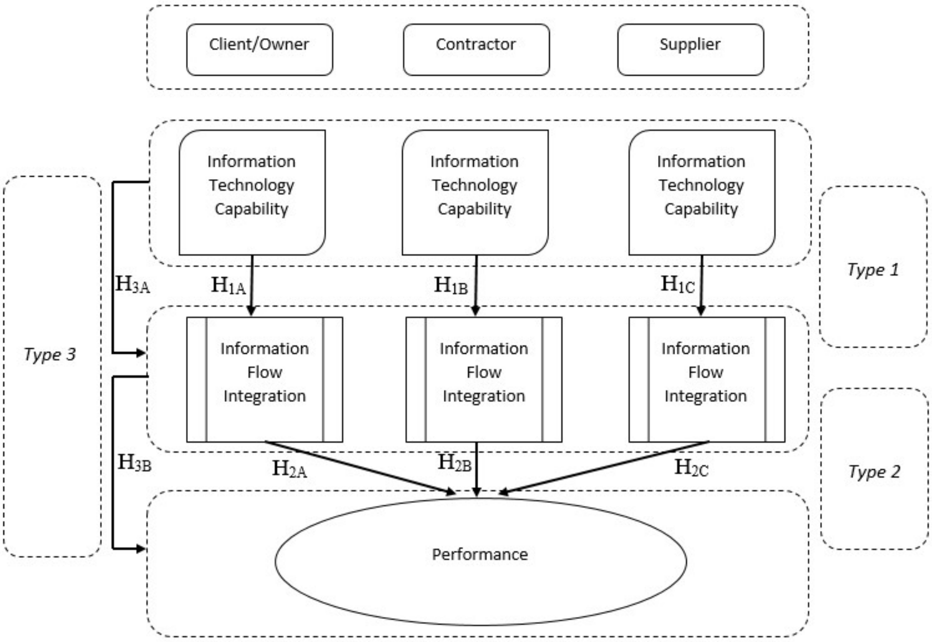

Figure 1: Research framework

RESEARCH METHODOLOGY

The collected data is analyzed in two parts. In the first part of the analysis demographics of respondents are recorded with the help of some basic descriptive statistics of percentage and frequency. Missing data is a widespread problem in data-driven modeling. The lack of data may generate partiality in the statistical analysis, resulting in incorrect results (Zhang & Thorburn, 2022). Furthermore, because most methods for data modeling assume exhaustive details for every parameter included, missing data renders them worthless (Soley-Bori, 2013). As a result, effective approaches of dealing with missing data are of the utmost importance. According to researchers, the best strategy to deal with missing data is to prevent missing values through rigorous and well-planned data gathering (Wisniewski et al., 2006). Some of the few preventive tactics suggested by well-established research include defining a suitable audience and altering screened sample strategies (Kang, 2013). Respondents for this research were educated and employed professionals who genuinely grasp the nature of the Construction sector in the United Arab Emirates and Pakistan, resulting in a strong correlation between the demographics of the participants and the phenomenon under analysis. This guarantees that respondents truly comprehend the information they have been inquired for, thereby fostering an impression of relevance and involvement. In addition, we collected the information using Google Forms. To prevent missing data, the asterisk option has been used on every question, preventing respondents from moving on to the subsequent question prior to responding the initial one. This method has effectively solved the issue of missing values. The analysis of missing values is presented in Table 1.

Table 1: Missing values analysis

Client/Owner	Information flow Integration	Information technology Capability	Performance
Valid	40	40	40
Missing	0	0	0
Contractor			
Valid	39	39	39
Missing	0	0	0
Supplier			
Valid	41	41	41
Missing	0	0	0
Combine			
Valid	120	120	120
Missing	0	0	0

To check the fundamental assumption for statistical analysis, the normality of the data was tested using Skewness and Kurtosis statistics (Hair et al., 2010; Tabachnick & Fidell, 2013; Kline, 2011). To consider the assumption of data normality the values should fall between -2 to +2 for skewness and -7 to +7 for kurtosis (Kline, 2011). The values in Table 2 suggest that collected data has acceptable values for all organizational entities of Client/Owner, Contractor, Supplier and their combined data.

Table 2: Results of skewness and kurtosis normality tests

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Client/Owner							
Owner Information Flow Integration	40	2	5	3.39	0.772	-0.086	-0.614
Owner Information Technology Capability	40	2	5	3.11	0.712	0.087	-0.528
Owner Performance	40	2	5	3.39	0.572	0.142	-0.576
Contractor							
Contractor Information Flow Integration	39	2	4	3.05	0.645	0.277	-0.298
Contractor Information technology Capability	39	2	4	2.93	0.554	0.014	-0.644
Contractor Performance	39	2	4	3.07	0.606	0.086	-0.623
Supplier							
Supplier Information Flow Integration	41	2	5	3.28	0.797	0.183	-1.048
Supplier Information technology Capability	41	2	5	3.09	0.758	0.573	-0.375
Supplier Performance	41	2	5	3.39	0.718	0.024	-0.803
Combine							
Information Flow Integration	120	2	5	3.24	0.75	0.178	-0.758
Information technology Capability	120	2	5	3.05	0.681	0.37	-0.301
Performance	120	2	5	3.29	0.648	0.099	-0.603

Outliers are data points that differ greatly from the main pattern or distribution of the data in social science data analysis. Because these data points might have a detrimental impact on the interpretation and analysis of the data, they must be carefully addressed and handled (Aguinis et al.,2013). Based on this premise, the data is examined for outliers, as improving transparency and uniformity in outlier handling techniques can improve the reliability and replicability of research findings.

As illustrated in Figure 2, Figure 3 and Figure 4. These findings indicate that there are no outlier values in the data.

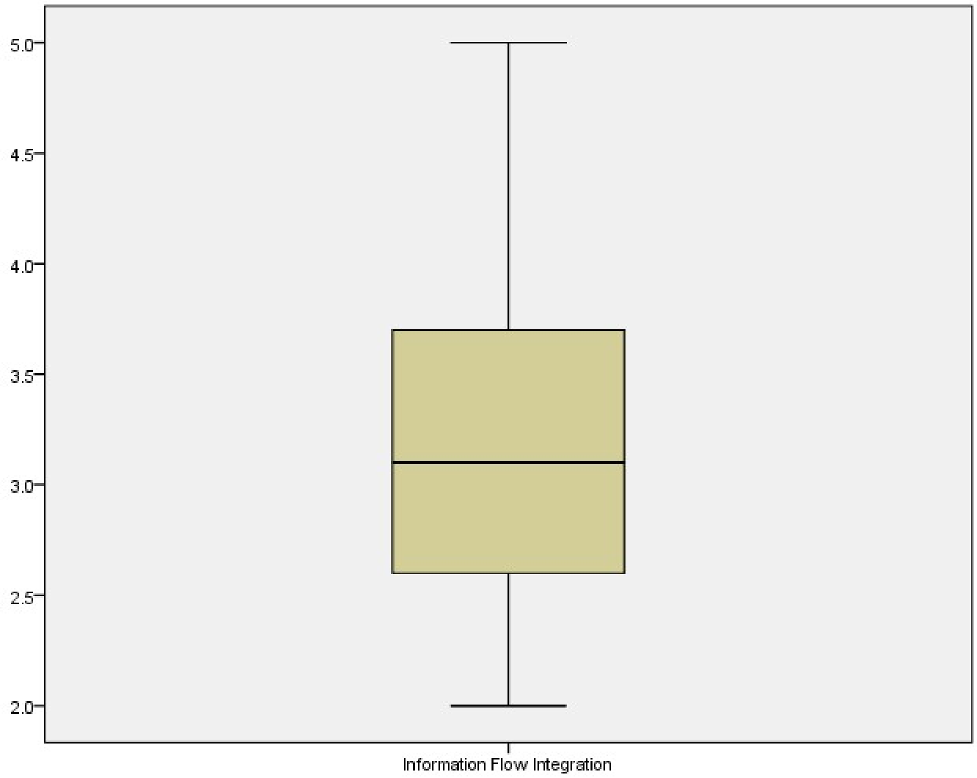

Figure 2: Outlier detection in data for information flow integration

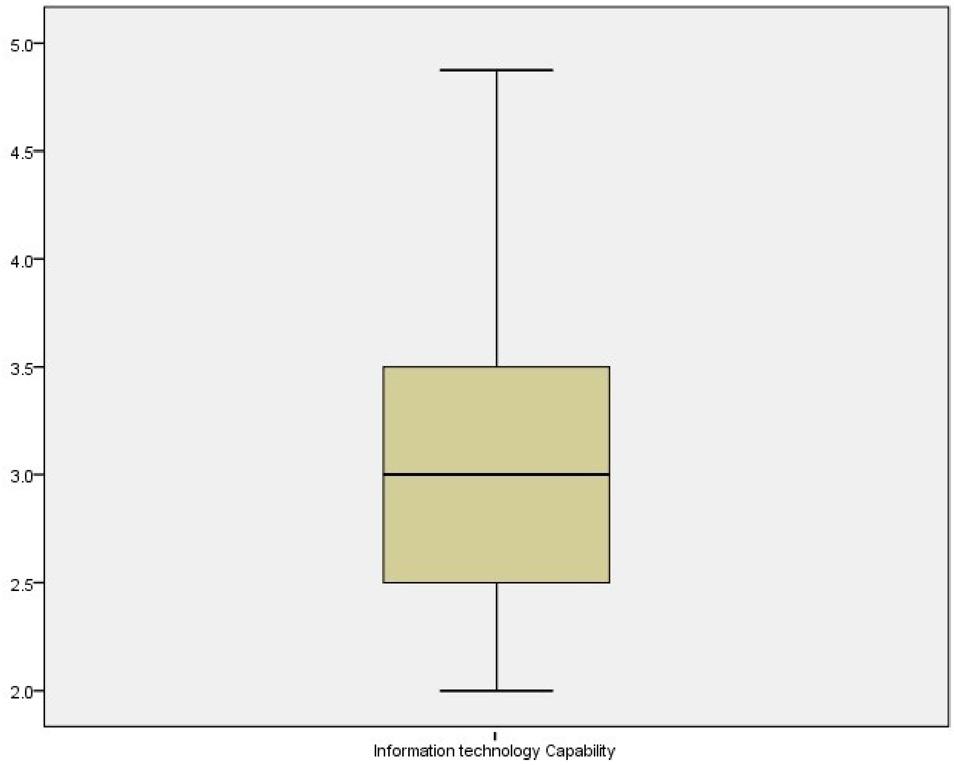

Figure 3: Outlier detection in data for information technology capability

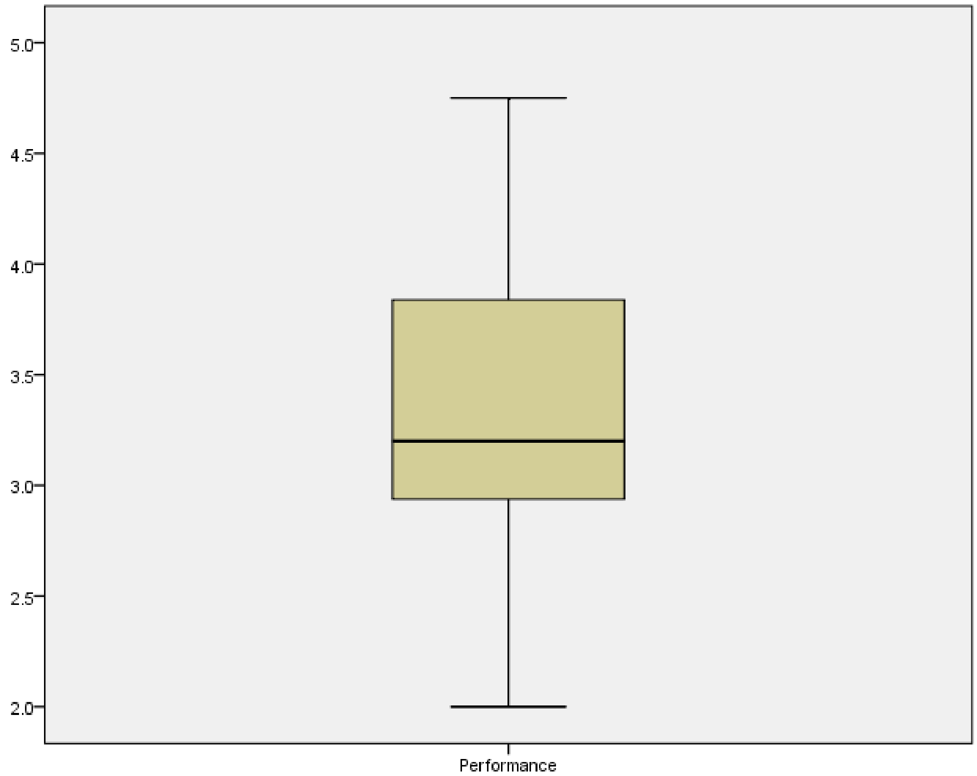

Figure 4: Outlier detection in data for performance capability

Second, to understand the perception of employees about the impact of Information Technology on the Performance of the project, relative importance index (RII) of items for each organization of Client/Owner, Contractor and Supplier was calculated. Similarly, a weighted average of each item is also computed to represent the perception of each firm's employees about the impact of Information Technology. The following equation was used to transform responses into Relative Importance Index (RII):

$$RII = \frac{\sum w}{HN} \quad (1)$$

In the above-mentioned equation, w is the weight ranging from 1 to 5; assigned by respondents to each factor, where H is the highest weight of 5 for this paper, N is the total number of responses that is 120, and RII indicates Relative Importance Index. This methodology of the Relative Importance Index (RII) has also been used by various researchers in the past years. A study focusing on identifying project management as a critical factor in Construction Project success used the same Relative Importance Index (RII) to rank the project's success factors based on their ranking (Aibinu & Jagboro, 2002). Another study of the South African Construction industry, also used the same methodology to rank key performance indicators for Sustainable infrastructure (Ugwu & Haupt, 2007). Research pertaining to the Construction industry with a special focus on the Performance of Construction Projects (Cheung et al., 2004); by managing multiple factors of Cost, time, delivery and Communication systems, supports the use of the Relative Importance Index (RII) (Iyer & Jha, 2005). Table 3 provides the Relative Importance Index (RII) and ranking of Performance indicators.

Table 3: Relative importance index (RII) and ranking of performance indicators

Code	IT impacts on Performance	Client/ Owner		Contractor		Supplier		Combine	
		RII	R	RII	R	RII	R	RII	R
P1	Projects will be able to meet their technical objectives	0.485	8	0.527	5	0.493	7	0.502	7
P2	Projects will be able to achieve the necessary registrations	0.545	3	0.585	3	0.527	4	0.55	3
P3	Projects will be able to meet their commercial objectives	0.52	4	0.569	4	0.532	3	0.54	4
P4	Projects will be able to develop products that will be manufacture with reasonable costs	0.515	5	0.538	6	0.498	6	0.517	5
P5	Projects maintained a consistent approach in tackling technical problems	0.545	2	0.6	2	0.556	2	0.567	2
P6	The work on projects has been able to overcome technical hurdles	0.505	6	0.533	7	0.502	5	0.513	6
P7	The work on projects has been able to conduct the tests it need to conduct at particular required stage of the project	0.57	1	0.605	1	0.576	1	0.583	1
P8	The work on projects have test results yielding positive results	0.495	7	0.523	8	0.478	8	0.498	8

RESULTS AND DISCUSSION

The complexity of construction is growing; thus experts are looking for reliable methods to back up their conclusions. These computational methods are more capable of producing original solutions to issues facing the construction sector. The availability of computer resources that can analyze massive volumes of data with the aid of complex algorithms provides strong support for the usage of computational analysis.

There is literature on the construction sector that uses linear and nonlinear regression techniques as a standard instrument of analysis to address the issues of construction cost modeling and demand forecasting (Goh & Teo, 2000). Regression analysis has been utilized in the construction industry to investigate data regarding the effectiveness of site operations, maximize productivity, and improve resource allocation. The comprehensive use of regression approaches results in the most useful outputs, from setting the objective to capitalize on productivity through technical features of construction equipment to managing construction projects (Halabi, et al., 2022). The results for the regression analysis is presented in Table 4.

Table 4: Regression Analysis Results

Type 1	**Independent**	**Dependent**	**Firm Type**	**N**	**R**	**R_2**	**Adjusted R_2**	***p*-value**
H_{1A}	Information Technology Capability	Information Flow Integration	Client/ Owner	40	0.304	0.092	0.068	0.057
H_{1B}	Information Technology Capability	Information Flow Integration	Contractor	39	0.634	0.401	0.385	0
H_{1C}	Information Technology Capability	Information Flow Integration	Supplier	41	0.758	0.574	0.563	0
Type 2	**Independent**	**Dependent**	**Firm Type**	**N**	**R**	**R_2**	**Adjusted R_2**	***p*-value**
H_{2A}	Performance	Information Flow Integration	Client/ Owner	40	0.435	0.19	0.168	0.005
H_{2B}	Performance	Information Flow Integration	Contractor	39	0.875	0.765	0.759	0
H_{2C}	Performance	Information Flow Integration	Supplier	41	0.814	0.663	0.655	0
Type 3	**Independent**	**Dependent**	**Firm Type**	**N**	**R**	**R_2**	**Adjusted R_2**	***p*-value**
H_{3A}	Information Technology Capability	Information Flow Integration	Combine	120	0.683	0.436	0.401	0
H_{3B}	Performance	Information Flow Integration	Combine	120	0.752	0.691	0.627	0

As per Table 4, the type 1 of hypothesis, regression analysis of the testing association between information flow integration as Dependent and Information Technology Capability as an Independent variable the results suggest that for Owner Information Technology Capability H_{1A}, R= 0.304, which is closer to 0, this illustrates a relationship between dependent and independent variables, however, it is not strong enough to have a significant effect. The R_2 value of 0.092, indicates that Owner Information Technology Capability can deliver a 9.2% shift in Owner

Information Flow Integration, which is not statistically significant because of $p > 0.05$. Further, for contractor-based organizations, there is a positive linear association between information technology capability and information flow integration with R = 0.634 and R_2 = 0.401, this linearly positive connection has the potential to change information flow integration by 40.1%. Similarly, The Supplier Information Technology Capability predictor variable's R-value of 0.758 suggests a linear positive association between the independent and dependent variables. The information technology capability can change the information flow integration of supplier-based enterprises by 57.4%, according to the R_2 value of 0.574.

The type 2 of Hypothesis testing results suggest that for Owner-based firms an association existed between Performance and Information Flow Integration with significant values, R= 0.435 and R_2 = 0.190 showing a 19% change in the project's performance. The strength of association for Information Flow Integration and Performance for Contractor and Supplier Firms is significant with $p < 0.05$ and R= 0.875 and R= 0.814 respectively.

Type 3 of hypothesis testing is focused on measuring the combined association between Information Technology Capability and Performance with Information Flow Integration of all the contributing entities of Client/Owner, Contractor and Supplier. The results suggest a positive association for Information Technology capability with Information Flow integration with R= 0.68, and the positive association between Performance and Information Flow Integration is also established with R= 0.752 with $p < 0.05$ in both tests.

Information Flow Integration is essential to the success of projects in the construction sector. This assertion is supported by a number of research publications that detail the issues caused by inadequate information and communication flow and how these issues have a direct influence on project time and expense (Kania et al., 2020). Project success has been linked to efficient information management and decision-making assistance at all stages starting from the pre-design stage till project completion (Bryde et al., 2013). Sharing of information among team members of Construction Projects has been proven to enhance the the overall Performance of the Project's team (Hasnain & Pasha, 2022). Similarly, managing communication between contractors and subcontractors, creating systems for quick problem resolution, and aligning information flow systems between contractors and suppliers are additional requirements for integrating multinational information flow in construction projects (Rizvanolli, 2016). The significance of communication and knowledge sharing among project participants has also been underlined because it promotes the project's successful completion and integration of significant information (Trach & Bushuyev, 2020).

Furthermore, to promote coordination and collaboration between project participants, it has been discovered that collaborative adoption of Information and Communications Technology (ICT) is beneficial to the flow of data and communication (Ahuja et al., 2009). Building Information Modeling/Management (BIM) is now required in the construction sector since it promotes collaboration among stakeholders and allows for the processing and storing of project data in a central location (Kocakaya et al., 2019).

Construction project success depends on effective information exchange and communication among project participants. Lack of good communication can cause challenges for project execution and can have a detrimental effect on project results. Therefore, to maximize communication between participants in building projects, it is crucial to establish tools, such as digital systems (Kania et al., 2020). Construction businesses have completely shut down as a result of the COVID-19 epidemic. For the success of the project and the integration of the information flow, information technology competency becomes even more crucial in these uncertain circumstances. Project teams can continue working despite physical limitations with the help of digital technologies and systems that enable remote cooperation and communication (Gamil & Alhagar, 2020). In addition, project performance and information flow integration depend on project management information control systems (Xia et al.,2018). These systems aid in the management of project data and documentation, ensuring that the appropriate data is made available to the appropriate individuals at the appropriate time. Literature also suggests that the use of IT has a stronger impact on upstream integration, indicating its significance in improving the overall performance of construction projects (Vanpoucke et al., 2017). Thus, by fostering collaboration and communication among project participants, efficient information control systems help construction projects succeed.

CONCLUSION

In conclusion, information flow integration is essential to the success of building projects. It enhances participant coordination, decision-making, and teamwork, resulting in successful project management and cost-effective solutions. Information technology capability and the degree of functional integration were found to have an advantageous influence on project performance in a study of UAE projects. This shows that utilizing Information Technology effectively and collaborating with other construction-related organizations can improve project upshots (Hasnain & Pasha, 2022).

Construction projects can benefit from enhanced information flow and, ultimately, greater project performance by putting into practice techniques like BIM, ICT adoption, and standardized information exchange. The adoption of Industry 4.0 technologies, such as digitalization, building information modeling (BIM), and the Internet of Things (IOT), is also crucial for improving project performance in the construction industry (Demirkesen & Tezel, 2021). These technologies enable better information flow and integration, leading to more efficient project management and decision-making. However, it is important to note that the focus should not be solely on the implementation of BIM but also on other advanced technologies within Industry 4.0 (Newman et al., 2020).

It is concluded that information technology capability is essential for the performance and information flow integration of projects in the construction industry. Effective communication, remote collaboration, standardization, lean practices, project management information control systems, and the adoption of Industry 4.0 technologies all contribute to improved project outcomes. Digital tools and systems play a crucial role in enabling these capabilities and should be leveraged to enhance project performance in the construction industry.

Subsequent investigations within the construction sector ought to concentrate on investigating the leadership competencies that project managers require in order to efficiently oversee sustainable construction projects (Latiffi & Zulkiffli, 2021). This emphasis on leadership abilities is essential for guaranteeing the effective implementation of projects in line with sustainable practices, meeting the changing needs of the construction sector, and resulting in socially and environmentally responsible outcomes. Further research is also necessary in the areas of developing new technologies for high-risk construction projects like tunnel construction and using BIM technology to manage the construction of green buildings. Furthermore, future research can be directed towards facilitating bi-directional coordination in the construction industry through the integration of building information models and physical construction through cyber-physical systems. This can be accomplished by using cyber-physical systems to integrate building information models with actual construction. This kind of approach would create a more cohesive and integrated framework for better coordination in the construction industry by combining digital representations with physical construction processes.

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